

Amendments of the Claims:

A detailed listing of all claims in the application is presented below. This listing of claims will replace all prior versions, and listings, of claims in the application. All claims being currently amended are submitted with markings to indicate the changes that have been made relative to immediate prior version of the claims. The changes in any amended claim are being shown by strikethrough (for deleted matter) or underlined (for added matter).

1. (Currently Amended) A phaser for adjusting timing between a camshaft and a timing gear coupled to a crankshaft of an engine, comprising:

a rotor having a plurality of circumferentially spaced apart vanes and a central cylindrical recess located along an axis of rotation, the rotor being connectable to the camshaft for rotation therewith;

a housing connectable to the timing gear for rotation therewith, having a body coaxially surrounding the rotor, the body having a plurality of recesses circumferentially spaced apart for receiving the vanes of the rotor, and permitting rotational movement of the vanes therein, wherein each of the vanes divides one of the recesses into a first portion and a second portion, the first portion and the second portion of the recesses being capable of sustaining fluid pressure, such that introduction of a fluid under pressure into the first portion causes the rotor to move in a first rotational direction relative to the housing and introduction of a fluid under pressure into the second portion causes the rotor to move in an opposite rotational direction relative to the housing;

a spool located within the cylindrical recess of the rotor and being slidably movable along the axis of rotation of the rotor, the spool comprising a plurality of lands which block and connect a plurality of passageways in the rotor, such that by slidably moving the spool in the cylindrical recess of the rotor, the flow of fluid from a fluid input to the first portion and the second portion is controlled, varying the rotational movement of the housing relative to the rotor; and

an inlet check valve located in the rotor, wherein the inlet check valve controls a backflow of fluid entering the fluid input;

wherein the spool comprises length and a first land and a second land, spaced apart a distance along the length, such that the first land and the second land have a circumference which provides a fluid blocking fit in the cylindrical recess, and the length has a lesser circumference than the first land and second land to permit fluid to flow; and

the cylindrical recess of the rotor comprising, in spaced-apart relationship along a length of the cylindrical recess from a first end of the cylindrical recess most distant from the camshaft to a second end of the cylindrical recess closest to the camshaft:

a first exhaust vent connecting the cylindrical recess to atmosphere;

a first return line connecting the first portion to the cylindrical recess;

a first movement line connecting the cylindrical recess to the first portion;

a central inlet line connecting a central location in the cylindrical recess to a source of fluid;

a second movement line connecting the cylindrical recess to the second portion;

a second return line connecting the second portion to the cylindrical recess;

a second exhaust vent connecting the cylindrical recess to atmosphere;

the first exhaust vent, second exhaust vent, first return line, second return line, first movement line, second movement line and central inlet line being spaced apart along the length of the cylindrical recess, and the first land and the second land being of sufficient length and distance apart such that:

when the spool is in a central position between the first end of the central recess and the second end of the central recess, the first land blocks the first

return line and the first movement line, and the second land blocks the second movement line and the second return line;

when the spool is in a position nearer the first end of the central recess, the first movement line and second return line are unblocked, fluid from the central inlet line flows into the first movement line and the first portion, and fluid from the second portion flows into the second return line and the second exhaust vent; and

when the spool is in a position nearer the second end of the central recess, the second movement line and first return line are unblocked, fluid from the central inlet line flows into the second movement line and the second portion, and fluid from the first portion flows into the first return line and the first exhaust vent.

2. (Cancelled)
3. (Original) The phaser of claim 1, further comprising a variable force actuator, such that the variable force actuator controls the position of the spool in response to a signal issued from an engine control unit.
4. (Original) The phaser of claim 3, wherein the variable force actuator is an electromechanical variable force solenoid.
5. (Original) The phaser of claim 4, further comprising a spring for biasing the spool valve to a full advance position during periods when the electromechanical variable force solenoid is deenergized.
6. (Original) The phaser of claim 3, wherein the variable force actuator is a pulse-width modulated solenoid.
7. (Original) The phaser of claim 1, wherein the fluid comprises engine lubricating oil.
8. (Currently Amended) An internal combustion engine, comprising:

a crankshaft, the crankshaft being rotatable about a first axis;

a camshaft, the camshaft being rotatable about a second axis, the camshaft being subject to torque reversals during rotation thereof;

a phaser for adjusting timing between a camshaft and a timing gear coupled to a crankshaft of an engine, comprising:

a rotor having a plurality of circumferentially spaced apart vanes and a central cylindrical recess located along an axis of rotation, the rotor being connectable to the camshaft for rotation therewith;

a housing connectable to the timing gear for rotation therewith, having a body coaxially surrounding the rotor, the body having a plurality of recesses circumferentially spaced apart for receiving the vanes of the rotor, and permitting rotational movement of the vanes therein, wherein each of the vanes divides one of the recesses into a first portion and a second portion, the first portion and the second portion of the recesses being capable of sustaining fluid pressure, such that introduction of a fluid under pressure into the first portion causes the rotor to move in a first rotational direction relative to the housing and introduction of a fluid under pressure into the second portion causes the rotor to move in an opposite rotational direction relative to the housing;

a spool located within the cylindrical recess of the rotor and being slidably movable along the axis of rotation of the rotor, the spool comprising a plurality of lands which block and connect a plurality of passageways in the rotor, such that by slidably moving the spool in the cylindrical recess of the rotor, the flow of fluid from a fluid input to the first portion and the second portion is controlled, varying the rotational movement of the housing relative to the rotor;

an electromechanical actuator mechanically coupled to the spool;

an engine control unit coupled to the electromechanical actuator, such that the electromechanical actuator controls the position of the spool in response to a signal issued from the engine control unit; and

an inlet check valve located in the rotor, wherein the inlet check valve controls a backflow of fluid entering the fluid input;

wherein the spool comprises length and a first land and a second land, spaced apart a distance along the length, such that the first land and the second land have a circumference which provides a fluid blocking fit in the cylindrical recess, and the length has a lesser circumference than the first land and second land to permit fluid to flow; and

the cylindrical recess of the rotor comprising, in spaced-apart relationship along a length of the cylindrical recess from a first end of the cylindrical recess most distant from the camshaft to a second end of the cylindrical recess closest to the camshaft:

a first exhaust vent connecting the cylindrical recess to atmosphere;

a first return line connecting the first portion to the cylindrical recess;

a first movement line connecting the cylindrical recess to the first portion;

a central inlet line connecting a central location in the cylindrical recess to a source of fluid;

a second movement line connecting the cylindrical recess to the second portion;

a second return line connecting the second portion to the cylindrical recess;

a second exhaust vent connecting the cylindrical recess to atmosphere;

the first exhaust vent, second exhaust vent, first return line, second return line, first movement line, second movement line and central inlet line being spaced apart

along the length of the cylindrical recess, and the first land and the second land being of sufficient length and distance apart such that:

when the spool is in a central position between the first end of the central recess and the second end of the central recess, the first land blocks the first return line and the first movement line, and the second land blocks the second movement line and the second return line;

when the spool is in a position nearer the first end of the central recess, the first movement line and second return line are unblocked, fluid from the central inlet line flows into the first movement line and the first portion, and fluid from the second portion flows into the second return line and the second exhaust vent; and

when the spool is in a position nearer the second end of the central recess, the second movement line and first return line are unblocked, fluid from the central inlet line flows into the second movement line and the second portion, and fluid from the first portion flows into the first return line and the first exhaust vent.

9. (Cancelled)

10. (Original) The internal combustion engine of claim 8, further comprising a variable force actuator, such that the variable force actuator controls the position of the spool in response to a signal issued from an engine control unit.

11. (Original) The internal combustion engine of claim 10, wherein the variable force actuator is an electromechanical variable force solenoid.

12. (Original) The internal combustion engine of claim 11, further comprising a spring for biasing the spool valve to a full advance position during periods when the electromechanical variable force solenoid is deenergized.

13. (Original) The internal combustion engine of claim 10, wherein the variable force actuator is a pulse-width modulated solenoid.

14. (Original) The internal combustion engine of claim 8, wherein the fluid comprises engine lubricating oil.